Claims

1. A head protecting body for a safety helmet, comprising an outer shell made of a rigid material and an impact-on-the-head absorbing liner arranged inside said outer shell,

said impact-on-the-head absorbing liner comprising a first liner member, and a second liner member having a density lower than that of said first liner member and overlapping with said first liner member at least partially,

wherein said first liner member comprises a swell for reinforcing at least one region of a forehead region, a left temple region, a right temple region and an occiput region in an overlapping region with respect to said second liner member on an overlapping surface side of said first liner member, said swell having a thickness larger than that of a portion of said first liner member which excludes said swell in said overlapping region,

said second liner comprises a hollow having a shape substantially corresponding to said swell in an overlapping region with respect to said first liner member, the hollow having a thickness smaller than that of a portion of said second liner member which excludes the hollow of the overlapping region, and

said swell is fitted in the hollow.

2. A head protecting body according to claim 1, wherein said swell is formed only within a region formed of said

forehead region and a front half of a vertex region.

3. A head protecting body according to claim 1, wherein said swell is formed only within said forehead region.

4. A head protecting body according to claims 1, wherein said swell includes a forehead region reinforcing swell.

5. A head protecting body according to claim 1,

Wherein said first liner member and said second liner member are both made of a foamed body of a synthetic resin, and

a percentage of a density of said second liner member to a density of said first liner member falls within a range of 25% to 85%.

6. A head protecting body according to claim 1,

Wherein said first liner member and said second liner member are both made of a foamed body of a synthetic resin, and

a percentage of a density of said second liner member to a density of said first liner member falls within a range of 35% to 75%.

7. A head protecting body according to claim 5, wherein a density of said first liner member falls within a range of 20 g/liter to 70 g/liter.

8. A head protecting body according to claim 6, wherein a density of said first liner member falls within a range of 30 g/liter to 60 g/liter.

9. A head protecting body according to claims 7,

wherein a density of said second liner member falls within a range of 5 g/liter to 45 g/liter.

10. A head protecting body according to claims 8, wherein a density of said second liner member falls within a range of 10 g/liter to 40 g/liter.

11. A head protecting body according to claim 1,

wherein said first liner member comprises a main liner member,

said second liner member comprises an auxiliary liner member,

a surface recess having a shape substantially corresponding to that of said auxiliary liner member is formed in a surface of said main liner member, and

said auxiliary liner member is placed in the surface recess.

12. A head protecting body according to claim 11, wherein said main liner member comprises a single molded product made of a synthetic resin foamed body.

13. A head protecting body according to claim 11,

wherein said main liner member comprises a composite main liner member comprising a main liner member main body having a central opening or central recess and a second auxiliary liner member having a density lower than that of said main liner member main body and placed in said central opening or central recess, and

said swell is formed substantially on said main liner

member main body.

14. A head protecting body according to claim 11, wherein said auxiliary liner member comprises a single molded product made of a synthetic resin foamed body.

15. A head protecting body according to claim 11, wherein said surface recess comprises an outer recess formed in an outer surface of said main liner member.

16. A head protecting body according to claim 11, wherein said surface recess comprises an inner recess formed in an inner surface of said main liner member.

17. A head protecting body according to claim 11,

wherein both of said auxiliary liner member and said surface recess extend from said forehead region to said occiput region through a vertex region of said impact-on-the-head absorbing liner, and

both of said swell and said hollow are formed substantially in said forehead region.

18. A head protecting body according to claim 11,

wherein said swell comprises a tableland, a thickness of which changes relatively small or does not change substantially, and a first thickness transient region extending from said tableland toward a vertex region such that a thickness of said main liner member decreases, and

the hollow comprises a lowland, a thickness of which changes comparatively small or does not change substantially, and a second thickness transient region extending from said

lowland toward said vertex region such that a thickness of said auxiliary liner member increases.

19. A head protecting body according to claim 11, wherein a development length between a lower end of said forehead region of said main liner member and a front end of said surface recess on a central plane in a left-to-right direction of said impact-on-the-head absorbing liner falls within a range of 0.5 cm to 4.5 cm.

20. A head protecting body according to claim 11, wherein a development length between a lower end of said forehead region of said main liner member and a front end of said surface recess on a central plane in a left-to-right direction of said impact-on-the-head absorbing liner falls within a range of 1 cm to 3 cm.

21. A head protecting body according to claim 11, wherein a development length between a lower end of said occiput region of said main liner member and a rear end of said surface recess on a central plane in a left-to-right direction of said impact-on-the-head absorbing liner falls within a range of 1 cm to 12 cm.

22. A head protecting body according to claim 11, wherein a development length between a lower end of said occiput region of said main liner member and a rear end of said surface recess on a central plane in a left-to-right direction of said impact-on-the-head absorbing liner falls within a range of 2.5 cm to 5.8 cm.

23. A head protecting body according to claim to 11, wherein a development length between a lower end of said left temple region of said main liner member and a left side end of said surface recess, and a development length between a lower end of said right temple region of said main liner member and a right side end of said surface recess, on a central plane in a back-and-forth direction of said impact-on-the-head absorbing liner, both fall within a range of 4 cm to 18 cm.

24. A head protecting body according to claim to 11, wherein a development length between a lower end of said left temple region of said main liner member and a left side end of said surface recess, and a development length between a lower end of said right temple region of said main liner member and a right side end of said surface recess, on a central plane in a back-and-forth direction of said impact-on-the-head absorbing liner, both fall within a range of 6 cm to 15 cm.

25. A head protecting body according to claim 11, wherein a development length of an open surface of said surface recess on a central plane in a left-to-right direction of said impact-on-the-head absorbing liner falls within a range of 20 cm to 55 cm.

26. A head protecting body according to claim 11, wherein a development length of an open surface of said surface recess on a central plane in a left-to-right direction of said impact-on-the-head absorbing liner falls within a range of 30 cm to 50 cm.

27. A head protecting body according to claim 11, wherein a development length of an open surface of said surface recess on a central plane in a left-to-right direction of said impact-on-the-head absorbing liner falls within a range of 15 cm to 50 cm.

28. A head protecting body according to claim 11, wherein a development length of an open surface of said surface recess on a central plane in a left-to-right direction of said impact-on-the-head absorbing liner falls within a range of 20 cm to 40 cm.

29. A head protecting body according to claim 11, wherein development lengths in a left-to-right direction of front and rear ends of said surface recess fall within a range of 8 cm to 26 cm.

30. A head protecting body according to claim 11, wherein development lengths in a left-to-right direction of front and rear ends of said surface recess fall within a range of 12 cm to 22 cm.

31. A head protecting body according to claim 18, wherein average development lengths in a back-and-forth direction of said tableland and said lowland fall within a range of 2.5 cm to 12 cm.

32. A head protecting body according to claim 18, wherein average development lengths in a back-and-forth direction of said tableland and said lowland fall within a range of 4 cm to 9 cm.

33. A head protecting body according to claim 18, wherein average development lengths in a left-to-right direction of said tableland and said lowland fall within a range of 9 cm to 28 cm.

34. A head protecting body according to claim 18, wherein average development lengths in a left-to-right direction of said tableland and said lowland fall within a range of 13 cm to 24 cm.

35. A head protecting body according to claim 18, wherein development lengths in a back-and-forth direction of said first and second thickness transient regions fall within a range of 1 cm to 6 cm.

36. A head protecting body according to claim 18, wherein development lengths in a back-and-forth direction of said first and second thickness transient regions fall within a range of 2 cm to 4.5 cm.

37. A head protecting body according to claim 18, wherein development lengths in a left-to-right direction of said first and second thickness transient regions fall within a range of 11 cm to 32 cm.

38. A head protecting body according to claim 18, wherein development lengths in a left-to-right direction of said first and second thickness transient regions fall within a range of 15 cm to 28 cm.

39. A head protecting body according to claims 11, wherein development areas of said tableland and said lowland

fall within a range of 50 cm^2 to 220 cm^2.

40. A head protecting body according to claims 18, wherein development areas of said tableland and said lowland fall within a range of 75 cm^2 to 160 cm^2.

41. A head protecting body according to claim 18, wherein development areas of said first and second thickness transient regions fall within a range of 25 cm^2 to 140 cm^2.

42. A head protecting body according to claim 18, wherein development areas of said first and second thickness transient regions fall within a range of 35 cm^2 to 100 cm^2.

43. A head protecting body according to claim 18, wherein a development area of a portion of a bottom surface of said surface recess of said main liner member which excludes said swell, and a development area of a portion of an overlapping side surface of said auxiliary liner member which excludes the hollow fall within a range of 250 cm^2 to 1,000 cm^2.

44. A head protecting body according to claim 18, wherein a development area of a portion of a bottom surface of said surface recess of said main liner member which excludes said swell, and a development area of a portion of an overlapping side surface of said auxiliary liner member which excludes the hollow fall within a range of 400 cm^2 to 800 cm^2.

45. A head protecting body according to claim 18, wherein a ratio of a development area of said swell to a development area of a portion of a bottom surface of said surface recess of said main liner member which excludes said

swell, and a ratio of a development area of the hollow to a development area of a portion of the overlapping side surface of said auxiliary liner member which excludes the hollow fall within a range of 0.1 to 0.6.

46. A head protecting body according to claim 18, wherein a ratio of a development area of said swell to a development area of a portion of a bottom surface of said surface recess of said main liner member which excludes said swell, and a ratio of a development area of the hollow to a development area of a portion of the overlapping side surface of said auxiliary liner member which excludes the hollow fall within a range of 0.15 to 0.45.

47. A head protecting body according to claim 18, wherein a ratio of a development area of said tableland to a development area of a portion of a bottom surface of said surface recess of said main liner member which excludes said swell, and a ratio of a development area of said lowland to a development area of a portion of said auxiliary liner member which excludes the hollow fall within a range of 0.06 to 0.5.

48. A head protecting body according to claim 18, wherein a ratio of a development area of said tableland to a development area of a portion of a bottom surface of said surface recess of said main liner member which excludes said swell, and a ratio of a development area of said lowland to a development area of a portion of said auxiliary liner member which excludes the hollow fall within a range of 0.1 to 0.3.

49. A head protecting body according to claim 18, wherein a ratio of a development area of said first thickness transient region to a development area of said tableland, and a ratio of a development area of said second thickness transient region to a development area of said lowland fall within a range of 0.25 to 1.2.

50. A head protecting body according to claim 18, wherein a ratio of a development area of said first thickness transient region to a development area of said tableland, and a ratio of a development area of said second thickness transient region to a development area of said lowland fall within a range of 0.35 to 0.9.

51. A head protecting body according to claim 11, wherein an average thickness of a portion of said main liner member which excludes a portion where said surface recess is formed falls within a range of 1.5 cm to 8 cm.

52. A head protecting body according to claim 11, wherein an average thickness of a portion of said main liner member which excludes a portion where said surface recess is formed falls within a range of 2.5 cm to 6 cm.

53. A head protecting body according to claim 11, wherein an average thickness of a portion of said surface recess of said main liner member which excludes a swell falls within a range of 0.5 cm to 3 cm.

54. A head protecting body according to claim 11, wherein an average thickness of a portion of said surface recess

of said main liner member which excludes a swell falls within a range of 0.8 cm to 2.4 cm.

55. A head protecting body according to claim 18, wherein an average thickness of said tableland of said main liner member falls within a range of 1 cm to 6 cm.

56. A head protecting body according to claim 18, wherein an average thickness of said tableland of said main liner member falls within a range of 1.5 cm to 4.5 cm.

57. A head protecting body according to claim 18, wherein an average thickness of a portion of said auxiliary liner member which excludes the hollow, and an average depth of a portion of said surface recess of said main liner member which excludes said swell fall within a range of 0.8 cm to 5 cm.

58. A head protecting body according to claim 18, wherein an average thickness of a portion of said auxiliary liner member which excludes the hollow, and an average depth of a portion of said surface recess of said main liner member which excludes said swell fall within a range of 1.4 cm to 4 cm.

59. A head protecting body according to claim 18, wherein an average thickness of a lowland of said auxiliary liner member falls within a range of 0.3 cm to 2 cm.

60. A head protecting body according to claim 18, wherein an average thickness of a lowland of said auxiliary liner member falls within a range of 0.5 cm to 1.5 cm.

61. A head protecting body according to claim 18, wherein a ratio of an average thickness of said tableland to an

average thickness of a portion of a bottom surface of said surface recess of said main liner member which excludes said swell falls within a range of 1.2 to 4.

62. A head protecting body according to claim 18, wherein a ratio of an average thickness of said tableland to an average thickness of a portion of a bottom surface of said surface recess of said main liner member which excludes said swell falls within a range of 1.5 to 3.

63. A head protecting body according to claim 18, wherein a ratio of an average thickness of said lowland to an average thickness of a portion of said auxiliary liner member which excludes the hollow falls within a range of 1/5 to 4/5.

64. A head protecting body according to claim 18, wherein a ratio of an average thickness of said lowland to an average thickness of a portion of said auxiliary liner member which excludes the hollow falls within a range of 3/10 to 3/5.

65. A head protecting body according to claim 18, wherein a ratio of an average thickness of a portion of said auxiliary liner member which excludes a hollow to an average thickness of a portion of said surface recess of said main liner member which excludes said swell falls within a range of 1/2 to 4.

66. A head protecting body according to claim 18, wherein a ratio of an average thickness of a portion of said auxiliary liner member which excludes a hollow to an average thickness of a portion of said surface recess of said main liner

member which excludes said swell falls within a range of 1 to 3.

67. A head protecting body according to claim 18, wherein a ratio of an average thickness of said lowland of said auxiliary liner member to an average thickness of said tableland of said main liner member falls within a range of 1/12 to 5/6.

68. A head protecting body according to claim 18, wherein a ratio of an average thickness of said lowland of said auxiliary liner member to an average thickness of said tableland of said main liner member falls within a range of 1/6 to 2/3.

69. A head protecting body according to claim 18, wherein a ratio of an average thickness of said tableland to an average thickness of a portion of said main liner member which excludes a portion where said surface recess is formed falls within a range of 1/2 to 7/8.

70. A head protecting body according to claim 18, wherein a ratio of an average thickness of said tableland to an average thickness of a portion of said main liner member which excludes a portion where said surface recess is formed falls within a range of 2/3 to 5/6.

71. A head protecting body according to claim 13,

wherein each of said main liner member main body and said second auxiliary liner member is made of a foamed body of a synthetic resin, and

a percentage of a density of said second auxiliary liner member to a density of said main liner member main body falls within a range of 25% to 85%.

72. A head protecting body according to claim 13,

wherein each of said main liner member main body and said second auxiliary liner member is made of a foamed body of a synthetic resin, and

a percentage of a density of said second auxiliary liner member to a density of said main liner member main body falls within a range of 35% to 75%.

73. A head protecting body according to claim 13,

wherein each of said auxiliary liner member and said second auxiliary liner member is made of a foamed body of a synthetic resin, and

a percentage of a density of said second auxiliary liner member to a density of said auxiliary liner member falls within a range of 60% to 167%.

74. A head protecting body according to claim 13,

wherein each of said auxiliary liner member and said second auxiliary liner member is made of a foamed body of a synthetic resin, and

a percentage of a density of said second auxiliary liner member to a density of said auxiliary liner member falls within a range of 75% to 133%.

75. A head protecting body according to claim 13, wherein a density of said main liner member main body falls within a range of 20 g/liter to 70 g/liter.

76. A head protecting body according to claim 13, wherein a density of said main liner member main body falls

within a range of 30 g/liter to 60 g/liter.

77. A head protecting body according to claim 13, wherein a density of said second auxiliary liner member falls within a range of 5 g/liter to 45 g/liter.

78. A head protecting body according to claim 13, wherein a density of said second auxiliary liner member falls within a range of 10 g/liter to 40 g/liter.

79. A head protecting body according to claim 13, wherein a maximum value of a development length in a back-and-forth direction of said second auxiliary liner member and a maximum value of a development length in a back-and-forth direction of said central opening or central recess fall within a range of 12 cm to 42 cm.

80. A head protecting body according to claim 13, wherein a maximum value of a development length in a back-and-forth direction of said second auxiliary liner member and a maximum value of a development length in a back-and-forth direction of said central opening or central recess fall within a range of 18 cm to 36 cm.

81. A head protecting body according to claim 13, wherein a maximum value of a development length in a left-to-right direction of said second auxiliary liner member and a maximum value of a development length in a left-to-right direction of said central opening or central recess fall within a range of 10 cm to 36 cm.

82. A head protecting body according to claim 13,

wherein a maximum value of a development length in a left-to-right direction of said second auxiliary liner member and a maximum value of a development length in a left-to-right direction of said central opening or central recess fall within a range of 14 cm to 28 cm.

83. A head protecting body according to claim 13,

wherein said swell comprises a tableland, a thickness of which changes relatively small or does not change substantially, and a thickness transient region extending from said tableland toward a vertex region such that a thickness of said main liner member decreases, and

a ratio of an average thickness of said tableland of said main liner member to an average thickness of a portion of said main liner member which excludes a portion where said surface recess is formed falls within a range of 1/2 to 7/8.

84. A head protecting body according to claim 13,

wherein said swell comprises a tableland, a thickness of which changes relatively small or does not change substantially, and a thickness transient region extending from said tableland toward a vertex region such that a thickness of said main liner member decreases, and

a ratio of an average thickness of said tableland of said main liner member to an average thickness of a portion of said main liner member which excludes a portion where said surface recess is formed falls within a range of 2/3 to 5/6.

85. A head protecting body according to claim 13,

wherein a development area of an open surface of said central opening or central recess and a development area of a surface of said second auxiliary liner member on a side corresponding to said open surface fall within a range of 60 cm^2 to 600 cm^2.

86. A head protecting body according to claim 13, wherein a development area of an open surface of said central opening or central recess and a development area of a surface of said second auxiliary liner member on a side corresponding to said open surface fall within a range of 100 cm^2 to 360 cm^2.

87. A head protecting body according to claim 13, wherein a ratio of a development area of a surface of said second auxiliary liner member on a side opposite to said bottom surface to a development area of a portion of said bottom surface of said surface recess of said composite main liner member which excludes a swell falls within a range of 0.18 to 0.8.

88. A head protecting body according to claim 13, wherein a ratio of a development area of a surface of said second auxiliary liner member on a side opposite to said bottom surface to a development area of a portion of said bottom surface of said surface recess of said composite main liner member which excludes a swell falls within a range of 0.25 to 0.60.

89. A head protecting body according to claim 13, wherein an average thickness of said second auxiliary liner member and an average depth of said central opening or central

recess fall within a range of 0.5 cm to 3 cm.

90. A head protecting body according to claim 13, wherein an average thickness of said second auxiliary liner member and an average depth of said central opening or central recess fall within a range of 0.8 cm to 2.4 cm.

91. A head protecting body according to claim 13, wherein said central opening or central recess of said main liner member main body comprises a central opening.

92. A head protecting body according to claim 13, wherein each one of said auxiliary liner member, said main liner member main body and said second auxiliary liner member comprises a single molded product made of a synthetic resin foamed body.

93. A head protecting body according to claim 1, wherein the head protecting body further comprises a ventilation hole formed by an inner surface of said outer shell and a ventilation ridge groove formed in said impact-on-the-head absorbing liner.

94. A head protecting body according to claim 11, wherein the head protecting body further comprises a ventilation hole formed by a ventilation ridge groove formed in said main liner member and/or a ventilation ridge groove formed in said auxiliary liner member.

95. A head protecting body according to claim 1, wherein an average thickness of said outer shell falls within a range of 1 mm to 6 mm.

96. A head protecting body according to claim 1, wherein an average thickness of said outer shell falls within a range of 2 mm to 5 mm.

97. A safety helmet comprising a head protecting body having an outer shell made of a rigid material and an impact-on-the-head absorbing liner arranged inside said outer shell,

said impact-on-the-head absorbing liner comprising a first liner member, and a second liner member having a density lower than that of said first liner member and overlapping with said first liner member at least partially,

wherein said first liner member comprises a swell for reinforcing at least one region of a forehead region, a left temple region, a right temple region and an occiput region in an overlapping region with respect to said second liner member on an overlapping surface side of said first liner member, said swell having a thickness larger than that of a portion of said first liner member which excludes said swell in said overlapping region,

said second liner comprises a hollow having a shape substantially corresponding to said swell in an overlapping region with respect to said first liner member, the hollow having a thickness smaller than that of a portion of said second liner member which excludes the hollow of the overlapping region, and

said swell is fitted in the hollow.